Indigo2™ Product Guide

SiliconGraphics
Computer Systems

Silicon Graphics

INDIGO²

IMPACT

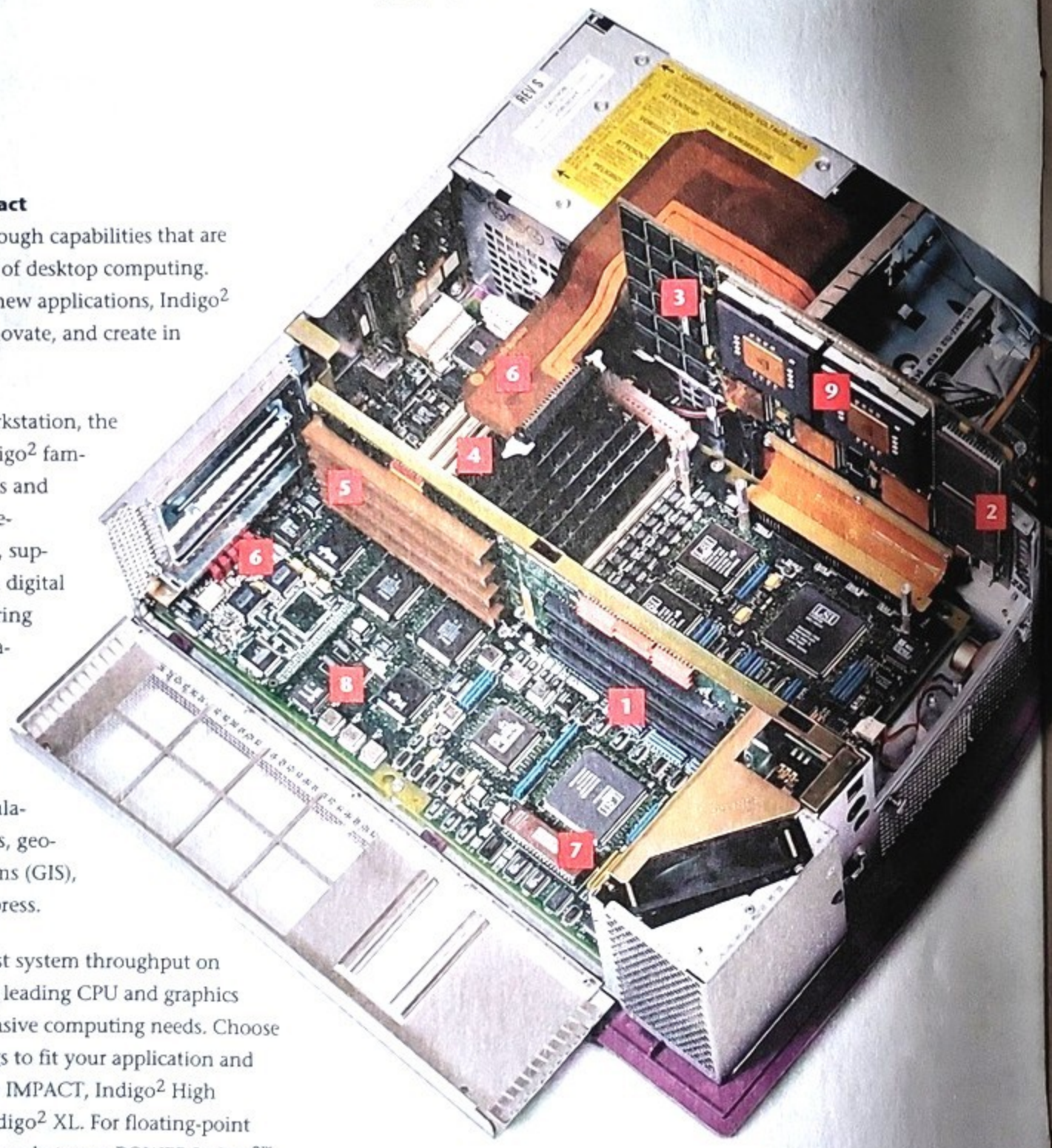
SiliconGraphics

1 High-Bandwidth Bus Architecture
High-speed 64-bit memory bus between the CPU and main memory runs at 400MB/sec while the 64-bit system bus runs at 267MB/sec

2 Upgradable High-Performance CPU
The processor module, which attaches to the baseboard, can be easily upgraded for higher performance

3 Large Cache for Maximum Application Performance
Increased memory system performance through 32KB on-chip cache and 2MB secondary cache (1MB for R4400/175 MHz)

4 Huge Memory Expansion
12 SIMM sockets allow for a maximum of 384MB RAM (640MB RAM for POWER Indigo²)



Indigo²: Making An Impact

Indigo²™ delivers breakthrough capabilities that are changing the world's view of desktop computing. Combined with powerful new applications, Indigo² lets you conceptualize, innovate, and create in new and powerful ways.

The Indigo² IMPACT™ workstation, the newest member of the Indigo² family, manipulates 3D models and pixel-based data at unprecedented performance levels, supporting tasks ranging from digital mock-up to volume rendering on the desktop. These capabilities deliver exponential productivity gains in key industries including manufacturing, entertainment, visual simulation, chemistry, oil and gas, geographic information systems (GIS), medical imaging, and prepress.

Indigo² provides the fastest system throughput on the desktop, balancing the leading CPU and graphics architectures for your intensive computing needs. Choose from four graphics offerings to fit your application and budget: Indigo² Maximum IMPACT, Indigo² High IMPACT, Indigo² XZ or Indigo² XL. For floating-point intensive applications, choose between POWER Indigo²™ Maximum IMPACT and POWER Indigo² XZ. All Indigo² workstations are multimedia-ready, with high-quality integrated audio and a complete range of video and compression capabilities. Your team can efficiently work together using the Mindshare™ collaborative environment, a set of tools that gives you easy and intuitive ways to express and share ideas. You can even create compelling 3D worlds for the World Wide Web using WebFORCE™ Indigo² IMPACT™.

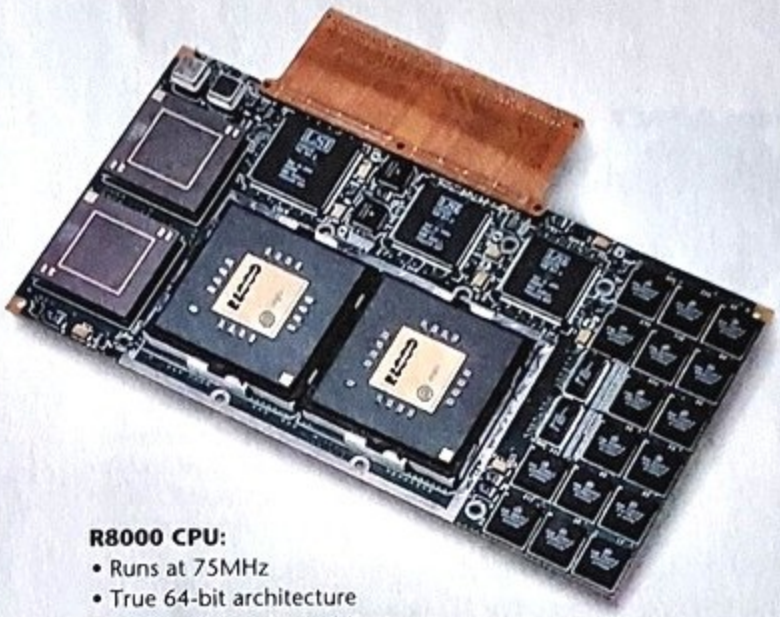
5 EISA Expandability
Three EISA slots for a multitude of expansion possibilities with up to 33MB/sec transfer rate

6 Two Fast SCSI-2 Channels
SCSI channels support a total of 10 SCSI devices for storage and I/O expansion

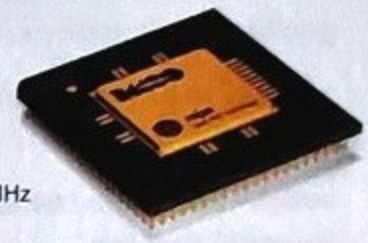
7 Built-In Networking
Ethernet, including both AUI and 10-BaseT, supplied with every system

8 Integrated Digital Media
Up to four simultaneous input and output audio channels, plus an integrated video bus

9 Powerful MIPS RISC Processor
R4400 for balanced integer and floating-point computations
R8000 for supercomputer-class floating-point performance



R8000 CPU:
- Runs at 75MHz
- True 64-bit architecture
- 4-way superscalar architecture
- 2MB global streaming cache
- Separate load and store buses
- 300 MFLOPS at peak performance
- Dual floating-point execution units



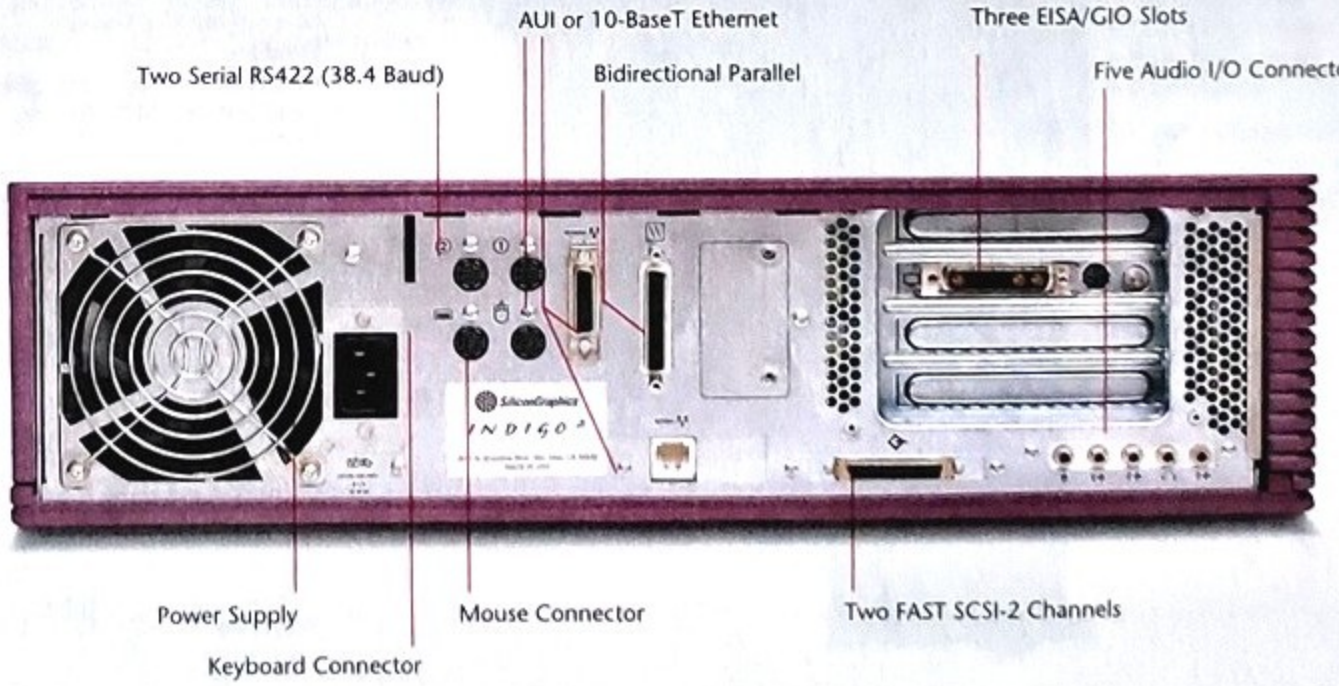
R4400 CPU:
- Available at 250, 200, and 175MHz
- True 64-bit architecture
- On-chip TLB for fast virtual-to-physical address translation
- 8-stage superpipeline architecture
- Large integrated caches

Powerful Processors

Indigo^2 leverages the leading MIPS® RISC processors: R4400™ for balanced floating-point and integer computations, and R8000™ for very large floating-point-intensive computational tasks. POWER Indigo^2, featuring the R8000 processor, with dual floating-point execution units and 2MB of global cache, delivers performance comparable to a Cray YMP™ for a fraction of the cost. Designed to provide a strong growth path, Indigo^2 and POWER Indigo^2 will also take full advantage of the next-generation microprocessor— MIPS RISC R10000™—when it becomes available.

Flexible Configurations

With its assortment of industry-standard networking and I/O capabilities, Indigo^2 is a flexible, expandable member of your computing environment. Its built-in functionality includes AUI and 10-BaseT Ethernet, two serial ports, a parallel port, and five audio connections. Peripheral configuration is facilitated by two independent FAST SCSI-2 controllers and three internal FAST SCSI-2 bays for hard-disk, DAT, floppy and CD-ROM drives. To meet your expandability requirements, Indigo^2 includes three industry-standard EISA slots, or 2 EISA slots and one GIO slot, to support additional cards for networking, video, compression, and more. Compliance with industry standards means that Indigo^2 integrates into multivendor environments. And Indigo^2 can read and write Macintosh® and PC files.

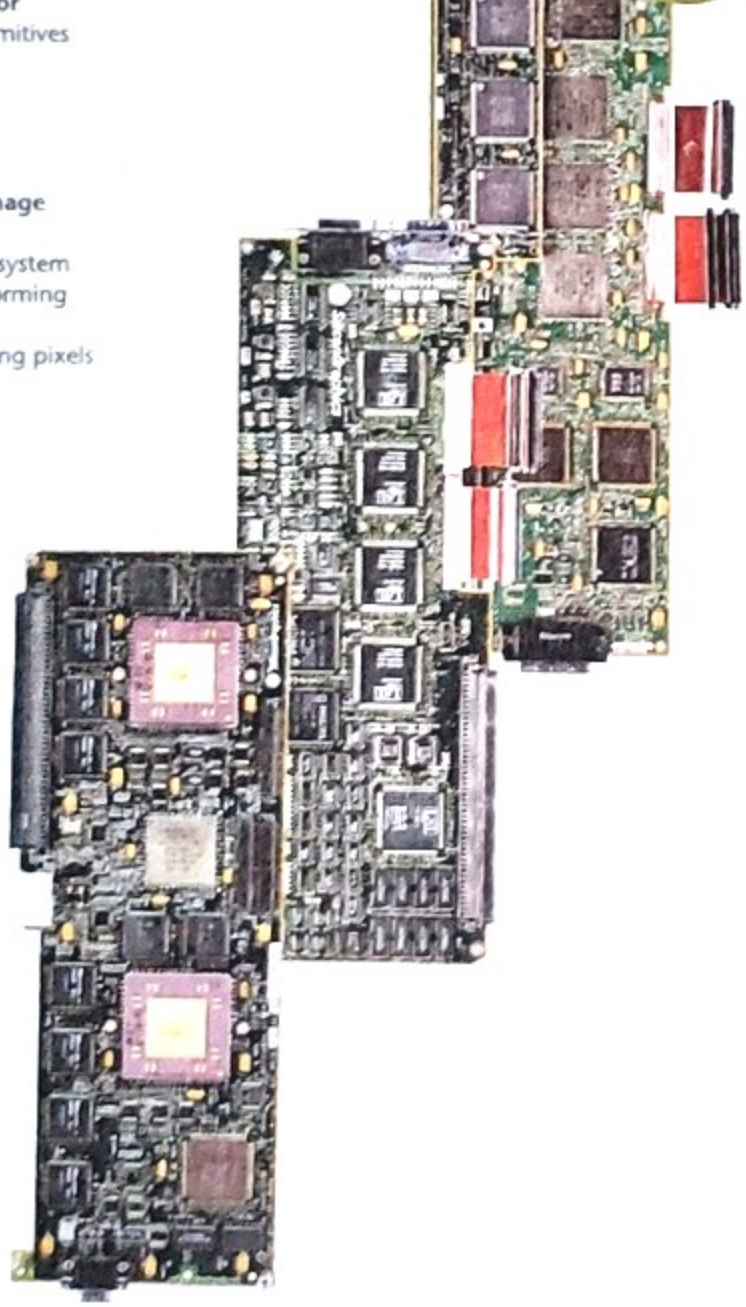


Indigo² Graphics

Indigo² includes a family of graphics offerings—Indigo² Maximum IMPACT, Indigo² High IMPACT, Indigo² XZ, and Indigo² XL—to suit a broad range of visual computing requirements. The new Indigo² IMPACT workstation delivers breakthrough capabilities by combining 3D graphics and imaging. Upgradable from all existing graphics configurations, Indigo² IMPACT is redefining desktop visualization. From extremely fast X and 2D graphics to a high-performance fully textured environment, the possibilities with Indigo² are astounding.

Indigo² Maximum IMPACT: The World's Most Powerful Desktop

With this flagship graphics subsystem, all modeling applications can take advantage of the unrivaled 3D performance in a fully textured environment. In addition, the parallel graphics architecture and the imaging subsystem allow you to combine compelling 3D surface models with interactive 3D volumes and 2D images. Ideal applications include visual simulation, high-end design, and post-production.



HQ3 Command Processor
- Distributes graphics primitives to Geometry Engine®
- GIO64 bus interface
- Pixel DMA engine
- 300,000 gates

Two GE11 Geometry/Image Engines
- Power the graphics subsystem
- 960 MFLOPS for transforming triangles
- 960 MIOPS for processing pixels
- 600,000 gates each

Two RE4 Raster Engines
- Provide the pixel-fill capabilities
- 234 Mpixels/sec gouraud fill rate
- 300,000 gates each

Two TE Texture Engines
- Fill, warp, and zoom image/texture data
- 295,000 gates each

One or Four MB Texture Memory
- Interpolates image/texture data and performs MIP-mapping interpolation
- 1MB of texture memory with expandability to 4MB through optional Mezzanine card
- 60,000 gates + 8 Mb DRAM for each MB

Four PP1 Pixel Pipe Processors
- Provide blending, depth and dithering
- 290,000 gates each

Live Video
- Expansion port supports Indigo² Mindshare Bundle, Indigo² IMPACT Video, Indigo² IMPACT Channel Option, or Indigo² Presenter

Indigo² High IMPACT: Integrated 3D and Imaging

Indigo² High IMPACT is the first desktop workstation to combine high-speed 3D graphics with fully integrated imaging capabilities. Ideal applications include game authoring, seismic interpretation, satellite image processing, and Web authoring.

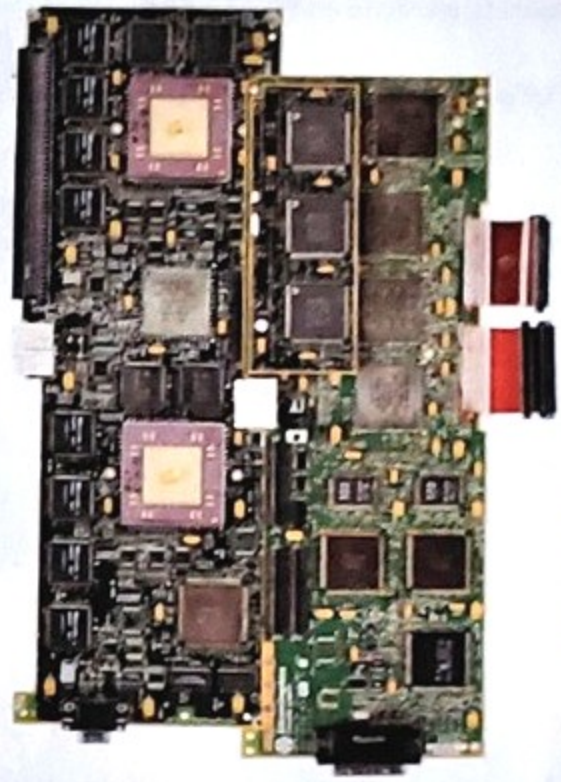
HQ3 Command Processor
- Distributes graphics primitives to Geometry Engine
- GIO64 bus interface
- Pixel DMA engine
- 300,000 gates

GE11 Geometry/Image Engine
- Powers the graphics subsystem
- 480 MFLOPS for transforming triangles
- 480 MIOPS for processing pixels
- 600,000 gates

RE4 Raster Engine
- Provides the pixel-fill capabilities
- 117 Mpixels/sec gouraud fill rate
- 300,000 gates

TE Texture Engine
- Fills, warps and zooms image/texture data
- 295,000 gates

One or Four MB Texture Memory
- Interpolates image/texture data and performs MIP-mapping interpolation
- 1MB of texture memory with expandability to 4MB through optional Mezzanine card
- 60,000 gates + 8Mb DRAM for each MB



Two PP1 Pixel Pipe Processors
- Provide blending, depth and dithering
- 290,000 gates each

Live Video
- Expansion port supports Indigo² Mindshare Bundle, Indigo² IMPACT Video, Indigo² IMPACT Channel Option, or Indigo² Presenter

Indigo² XZ : Fast Solids Modeling

Indigo² XZ, our leading CAD workstation, provides affordable high-performance solids modeling capability. Ideal applications include CAD, AEC, and entry-level animation.

Indigo² XL: Powerful Imaging

Indigo² XL graphics gives you extremely fast X and 2D graphics, while providing full-fledged 3D capability. Ideal applications include MCAD, publishing, and image processing.

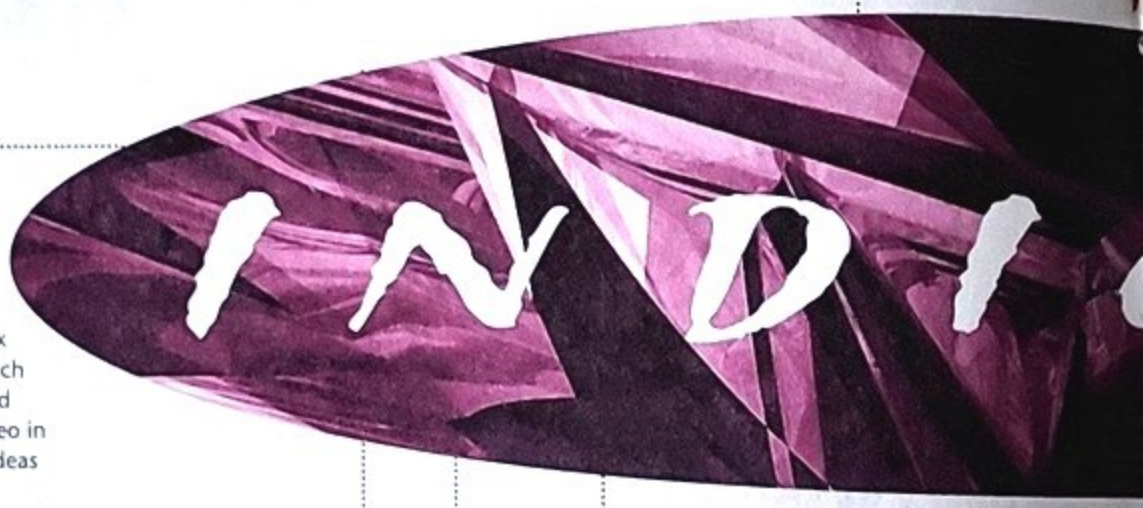
HQ2 Command Processor
- Distributes graphics primitives to Geometry Engine
- GIO64 bus interface
- Pixel DMA engine
- 80,000 gates

Four GE7 Geometry Engines
- Power the graphics subsystem
- 100 MFLOPS for transforming triangles
- 50,000 gates each

Integrated Raster Engine
- Provides the pixel-fill capabilities
- 37 Mpixels/sec gouraud fill rate
- 100,000 gates

Live Video
- Expansion port supports Indigo² Mindshare Bundle, Galileo Video, or Indigo² Presenter

Indigo^2 is making an impact across a broad spectrum of markets by introducing new ways to work, think, analyze, and visualize. Traditional industries benefit from the untraditional approaches that engineers discover when given enabling technologies. The new Indigo^2 IMPACT workstation inspires new solutions to problems and is contributing to the expanding range of high-volume applications tailored for Silicon Graphics computing platforms.



POST-PRODUCTION
Combine 3D models with complex images, paint on a 3D object, watch realistic previews of animations and effects, process uncompressed video in real time, experiment with more ideas faster, and much more.

OIL AND GAS
View large 3D volume datasets, integrate them with geological and engineering data, and generate accurate, easy-to-understand 3D earth models in real time.

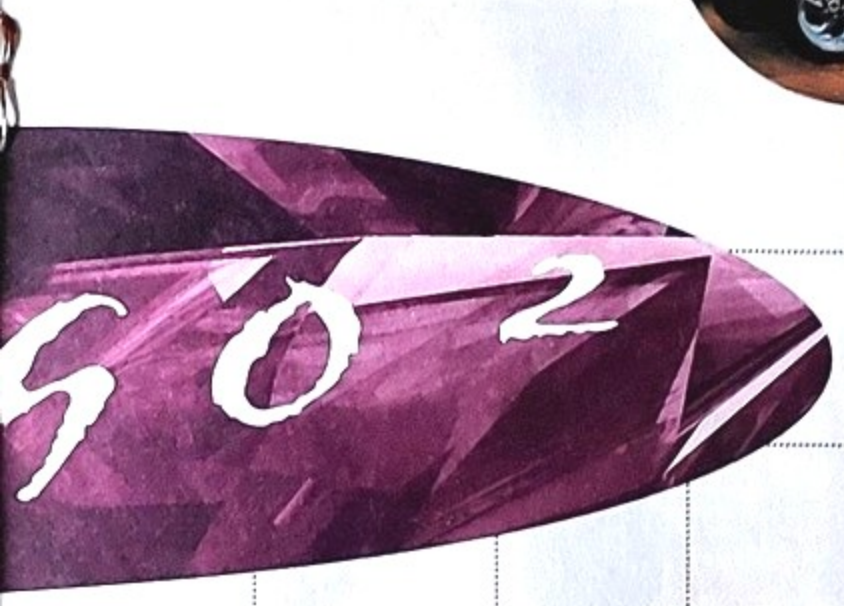
MEDICAL IMAGING
View and interact with 2D images and 3D volumes generated by CT, MRI, ultrasound, and other modalities.

PREPRESS
Manipulate, roam, zoom, and process large images with multiple layers in 12-bit accurate component color. Perform real-time color space conversions including CMYK and RGB with color correction.

GAMES
Seamlessly host the entire development process for next-generation games. Artists are given the freedom to create compelling unmatched 3D visuals for the next generation of winning games.

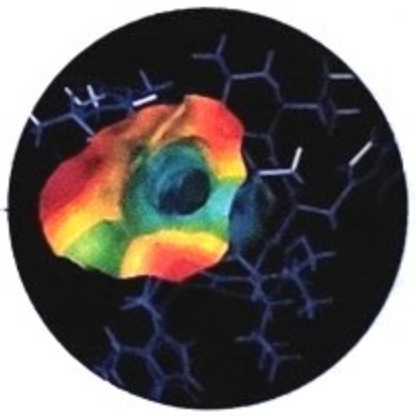
VISUAL SIMULATION
Create cost-effective real-time texture-mapped 3D graphics at unprecedented price points for training, simulation authoring, DIS, or mission planning.

MANUFACTURING
Maximize creativity and share ideas in visually compelling ways throughout all phases of product creation, including styling, design, digital mock-up or analysis.



GIS
Reduce data capture and map updating costs through high-performance image manipulation and visualization. Enhance decision support by integrating and visualizing large and disparate datasets.

AEC
Control, integrate, and visualize plant designs through the entire development cycle.



CHEMISTRY
Interactively create and explore complex molecular models and keep pace with the rapid expansion in chemical data—on the desktop.

Digital Media for Everyone

Whether you need video conferencing or broadcast solutions, Indigo² can meet the needs of a wide range of digital media applications because it was built with these capabilities in mind.

Built-in Audio I/O

From audio I/O to professional CD- or DAT-quality audio, the standard features of Indigo² can meet your requirements. Every Indigo² system includes I/O capabilities for a microphone (one is supplied), headphones, line in and line out, and stereo digital I/O, all with sample rates configurable to 48KHz.

Indigo² Video Mindshare Bundle

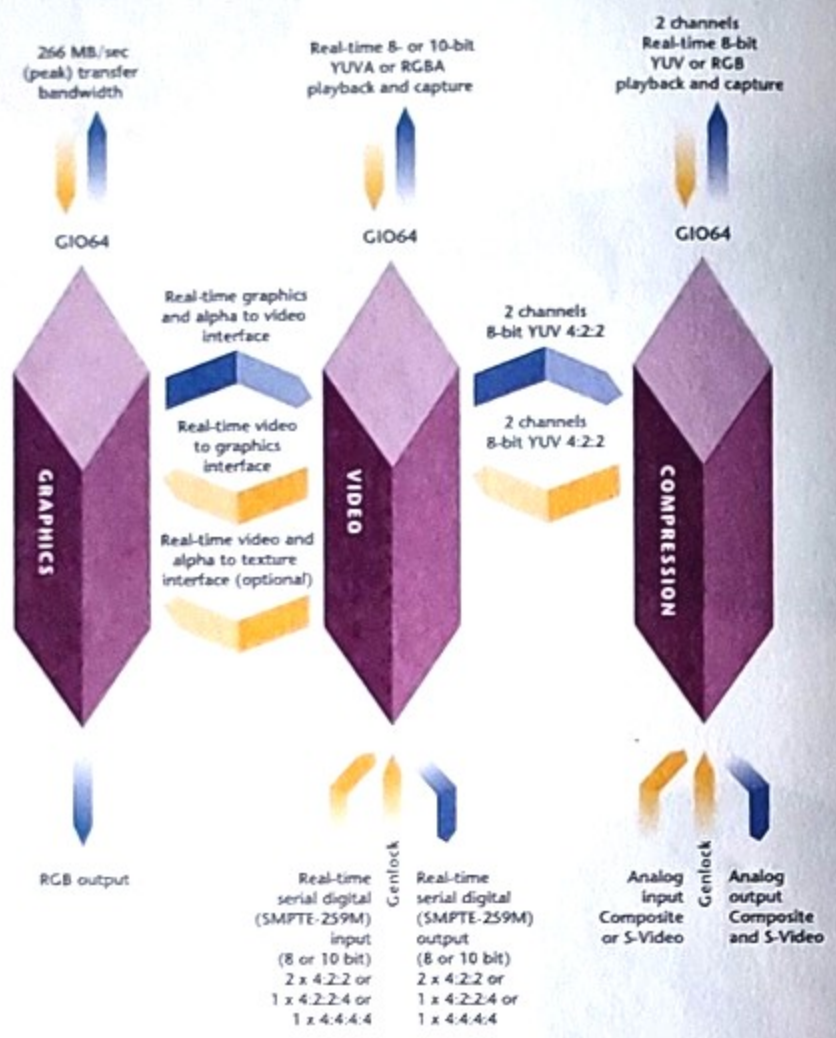
Combining video I/O capability with IndyCam™ and Mindshare software, Indigo² Video™ is the best solution for your team's collaborative efforts. In addition to sharing your ideas over the network, you can share your ideas on video tape, utilizing the print-to-video capability of Indigo² Video to send live graphics to any consumer VCR or camcorder.

Real-Time Digital Video I/O (Indigo² IMPACT)

Now the video professional has the ultimate video I/O solution, the Indigo² IMPACT Video™ serial digital video I/O option. Everything can be done in real time (see diagram)—get video into the system for immediate processing in paint, compositing, or editing applications, or utilize Indigo² IMPACT graphics for on-air applications to create real-time rendered graphics with key out. Couple this with the Indigo² IMPACT Compression™ motion JPEG option card and its low compression ratios (down to 2:1), and the possibilities become endless.

Two Streams of JPEG Compression (Indigo² IMPACT)

Used in stand-alone mode or coupled with Indigo² IMPACT Video, the Indigo² IMPACT Compression option meets many varied requirements. Indigo² IMPACT Compression allows animators, scientists, and engineers to preview animations and simulations or perform low-cost non-linear editing, while utilizing the full power of Indigo² Maximum IMPACT. For the broadcast and post-production professional, combining Indigo² IMPACT Compression with Indigo² IMPACT Video results in powerful solutions for high-quality non-linear editing, spot playback, compositing, and more.


266 MB/sec (peak) transfer bandwidth
Real-time 8- or 10-bit YUVA or RGBA playback and capture
2 channels Real-time 8-bit YUV or RGB playback and capture
GIO64
GIO64
GIO64
GRAPHICS
VIDEO
COMPRESSION
Real-time graphics and alpha to video interface
Real-time video to graphics interface
Real-time video and alpha to texture interface (optional)
2 channels 8-bit YUV 4:2:2
2 channels 8-bit YUV 4:2:2
RGB output
Real-time serial digital (SMPTE-259M) input (8 or 10 bit) 2 x 4:2:2 or 1 x 4:2:2:4 or 1 x 4:4:4:4
Genlock
Real-time serial digital (SMPTE-259M) output (8 or 10 bit) 2 x 4:2:2 or 1 x 4:2:2:4 or 1 x 4:4:4:4
Analog input Composite or S-Video
Genlock
Analog output Composite and S-Video

Indigo² IMPACT Digital Media

Indigo² XL/XZ Video Solutions

The Galileo Video™ option board provides high-quality video input and output. You can connect to any source ranging from composite, S-Video, and component analog to CCIR-601 digital video. Galileo also supports special effects such as fades and wipes. Cosmo Compress™, designed to partner with Galileo and Indigo² Video, gives you real-time video compression and decompression for intense video manipulation with compression ratios from 4:1 to 100:1.

Indigo² IMPACT Channel Option

Indigo² IMPACT Channel Option

The Indigo² IMPACT Channel Option (ICO) with Indigo² IMPACT gives you multiple video output channels and head-mounted display (HMD) formats for applications involving visual simulation, entertainment, and virtual reality. ICO converts digital information stored in the graphics frame buffer into multiple analog video signals, or channels, which can then be displayed on additional monitors and projection devices or head-mounted displays. The ICO option card also supports full-scene anti-aliasing at Super VGA, VGA or NTSC resolution for highest-quality visuals.

Dual-Head Option

For applications that require additional screen space, the Indigo² workstation supports a dual-head option. For programming flexibility, dual-head configurations support independent windows on each head for advanced data modeling and analysis applications. For example, one head can display a high-level view of the application data while the other head remains available for interactive analysis of the data.

ICO Output Formats

Resolution	Timing	Maximum # of Independent Channels
400 x 486 Interlaced	RS170-Field Sequential	2
640 x 480 Non-Interlaced	VGA Field Sequential	4 2
640 x 486 Interlaced	NTSC Full-Scene Anti-aliased NTSC	4* 1
800 x 486 Interlaced	RS170-Field Parallel RS170-Field Sequential	2 2
800 x 600 Non-Interlaced	SVGA	4
875 x 808 1025 x 946 1280 x 1024 Interlaced	Field Sequential	2

*2 channels flicker reduced, 4 channels non-flicker reduced

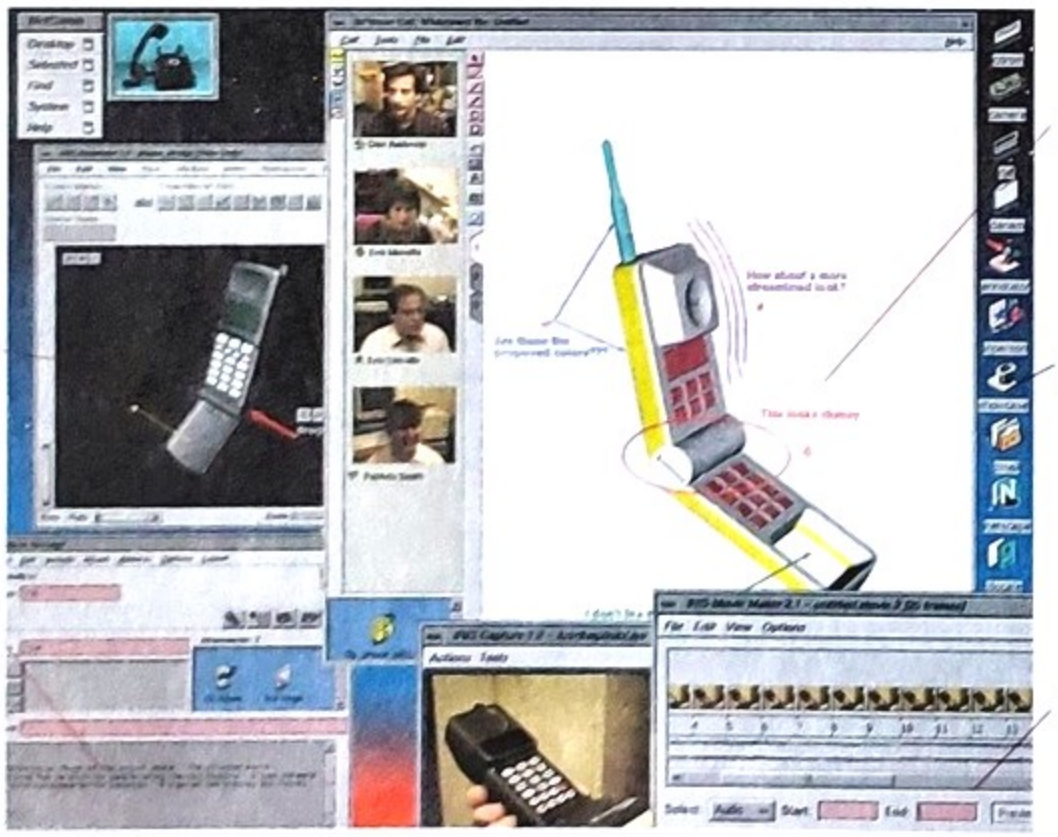
WebFORCE Indigo² IMPACT: Extraordinary 3D Authoring on the Web

The WebFORCE Indigo² IMPACT authoring station brings the powerful combination of Indigo² IMPACT graphics and R4400 CPU technology to the World Wide Web.

Use WebFORCE Indigo² IMPACT with the intuitive WebMagic™ authoring tools to create dazzling multimedia content. WebFORCE Indigo² IMPACT also provides an incredible combination of graphics horsepower and advanced features for use with Virtual Reality Modeling Language (VRML) and WebSpace™, the world's first commercially available 3D viewer. VRML allows you to describe 3D data and create 3D worlds on the Web, and WebSpace provides an easy-to-use 3D navigation interface.

Silicon Graphics Mindshare: A Collaborative Computing Environment

Mindshare lets your team share ideas effectively using the most suitable media: a human voice, engineering drawings, 3D models, video, a hand-drawn sketch, or written text. The Mindshare collaborative environment includes on-line tools for capturing, creating, and communicating your ideas. Support for high-end graphics, imaging, and high-quality audio and video means that Mindshare works the way you do.



For project revisions, mark up a 3D model with IRIS Annotator™

Store and forward using MediaMail™, IRIS Annotator, and print to video

Have interactive discussions using InPerson™

Create effective presentations using Showcase™

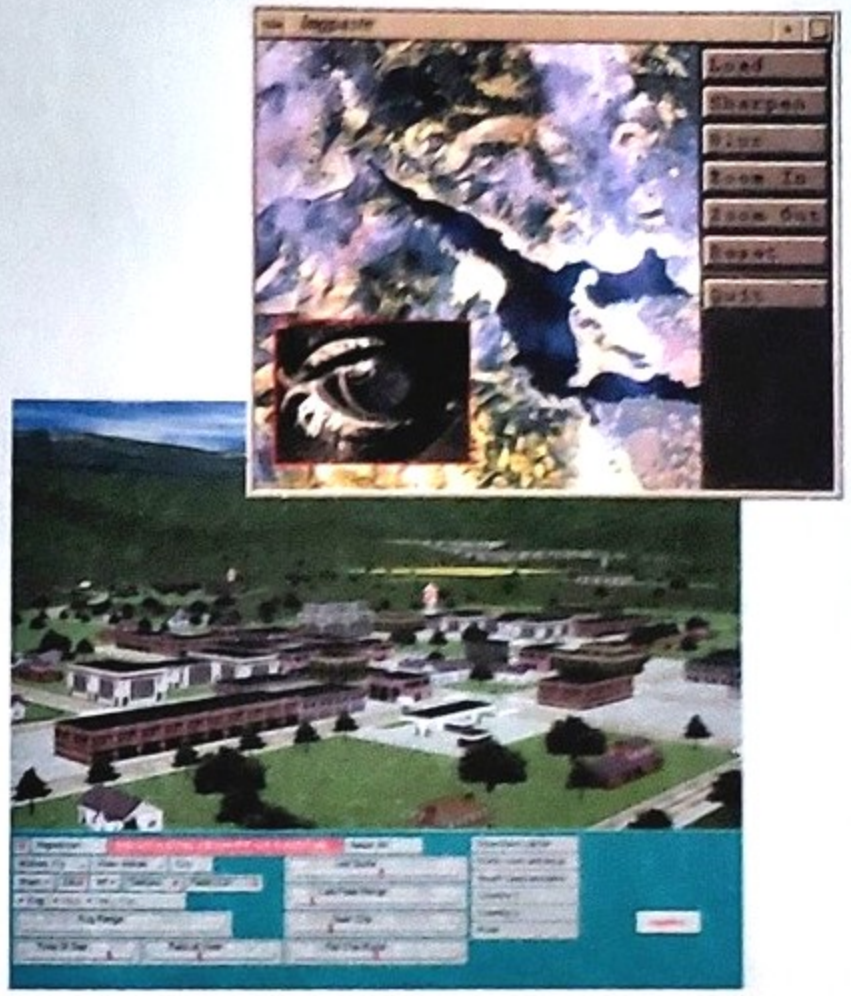
Create and capture ideas with Digital Media Tools

A Complete Advanced Graphics Solution
Developers take advantage of the power of Indigo^2 graphics using an array of graphics libraries and development environments.

OpenGL
OpenGL® is an industry-standard environment embraced by more than 30 companies. 2D, 3D, and imaging applications can be developed for a variety of hardware platforms with different operating and window systems. OpenGL includes operators for geometric and raster primitives, viewing and modeling transformations, as well as lighting, shading, blending, fog, hidden surface removal, texture mapping, and other graphics functions. These graphics functions are provided for every conforming OpenGL implementation, whether on a Silicon Graphics system, another vendor's workstation, or a PC. This makes applications written with OpenGL easily portable between platforms.

IRIS Performer
The IRIS Performer™ toolkit gives developers the means to achieve a fast, consistent frame rate for applications such as visual simulation, interactive entertainment, and simulation-based design. The IRIS Performer libraries are highly tuned for Indigo^2 IMPACT, and build on the functionality of OpenGL and the IRIX™ operating system. With the intelligence to evaluate underlying hardware, IRIS Performer simplifies the management of the visual database, and renders scenes at maximum speeds on all Silicon Graphics workstations.

ImageVision Library
The ImageVision Library® (IL) toolkit is an object-oriented extensible library for creating, processing, and displaying images. Its robust core set of image processing functions includes color conversion, arithmetic functions, radiometric and geometric transforms, statistics, spatial and non-spatial domain transforms, and edge, line, and spot detection. These functions simplify the extension of standard function sets to suit specific image processing needs.



Indigo^2: Ready For Tomorrow
Silicon Graphics anticipates the needs of tomorrow by delivering the most advanced and affordable workstations today. By starting with a flexible, standards-compliant UNIX® operating system and an open-system RISC architecture, Silicon Graphics protects your investment with upgradable microprocessors and power-to-grow scalability.

The Silicon Graphics family of graphics workstations is backed by superior service and technical support. At Silicon Graphics, we've always understood that no amount of technological leadership can meet customer needs without a responsive, well-trained, worldwide service and support infrastructure. As the established leader in visual supercomputing, we give our global customer base experienced technical support.

With breakthrough visualization and performance, Indigo^2 provides astounding productivity gains, allowing you to ascend to new levels. For more information on how Indigo^2 can help you make an impact, call Silicon Graphics today.

Technical Specifications

System

CPU/FPU	R4400™	R4400	R4400	R8000™
MHz	175MHz	200MHz	250MHz	75MHz
Primary Cache (I/D)	16K/16K	16K/16K	16K/16K	16K/16K
Secondary Cache	1MB	2MB	2MB	2MB
Memory Storage	32MB to 384MB (R4400) 32MB to 640MB (R8000)			
I/O	2 3 1/2" bays 1 5 1/4" half-height bay 2 Serial RS422 (38.4 k baud) 1 Bidirectional parallel 5 Audio I/O connectors 1 Ethernet (AUI or 10BaseT) 2 GIO-64 slots 4 EISA slots (total of 4 slots)			
SCSI	2 FAST SCSI - 2 channels			

Graphics

Advanced Features	Alpha blending Accumulation buffer Anti-aliased RGB lines and points Texture mapping Fog Lighting features Spot lighting Eight light sources Two-sided lighting Ambient, diffused, and specular Arbitrary clipping planes Depth cueing Soft shadow and depth of field Sub-pixel positioning Stenciling Stereo graphics Pan and zoom X11 pixel operations
Color Maps	2 (4096 colors each) XL 1 (4096 colors each)
IRIS GL™/OpenGL® Display Modes	RGBA quad buffer (stereo) RGBA double buffer RGBA single buffer Color index double buffer Color index single buffer * Color index double buffer overlay/underlay Color index single buffer overlay/underlay

* Available only on Indigo² IMPACT™

Audio/Video

Input	Mono/Stereo microphone (mono electret condenser microphone ships standard) Line-level stereo analog Serial digital stereo (IEC958)
Output	Stereo headphone output/mono (combined stereo) internal speaker Line-level stereo analog Serial digital stereo (IEC958)
Sampling Rates	48, 44.1, 32 KHz, and many lower rates Input and output rates are independent
Converters	Combined DAC and ADC 16-bit, delta-sigma, 64x-oversampling Two stereo audio codecs
Connectors	All 1/8-inch (3.5 mm) stereo jack
Video/Compression	Options available on all Indigo² systems
Genlock	Available through video options

GRAPHICS BENCHMARKS

Viewperf Performance Results (frames/sec.)

	XL	XZ	Indigo² High IMPACT*	Indigo² Maximum IMPACT*
CDRS Viewset Composite	N/A	N/A	19.83	38.90
Data Explorer Viewset Composite	N/A	1.64	6.45	12.71
Design Review Viewset Composite	N/A	N/A	3.52	6.95

*Preliminary

Graphics Primitives

	XL**	XZ	Indigo² High IMPACT*	Indigo² Maximum IMPACT*
X Lines	1.59M	441k	3.2M	3.2M
AA Depth cued (Fogged) Lines	25k	203k	1.2M	2.0M
Gouraud Tri Strips	68k	315k	1.1M	2.2M
Lit Gouraud Z Tri Strips	50k	176k	730k	1.46M
Lit Textured Gouraud Z Tri Strips	N/A	N/A	560k	1.1M
Lit Gouraud Z Independent Quads	18k	65k	300k	600k
Gouraud Fill (pixels/s)	89M	37M	117M	234M
Textured Gouraud Z Fill (pixels/s)	N/A	N/A	65M	130M
Convolutions 3x3 separable (comps/s)	N/A	N/A	30M	60M
Convolutions 3x3 general (comps/s)	N/A	N/A	20M	40M
Convolutions 5x5 separable (comps/s)	N/A	N/A	20M	40M
Color lookups (comps/s)	N/A	N/A	50M	100M

*Preliminary
**XL performance measured with 200 MHz R4400 processor

Processor Benchmarks

	R4400/175*	R4400/200	R4400/250*	R8000/75
AIM	118	140	N/A	N/A
SPEC 92int	123	140	176	113
SPEC 92fp	116	131	165	269
LINPACK 1000x1000DP	N/A	N/A	N/A	231

*Preliminary

Physical Environment

System	5" H x 18.5" W x 18.5" D; 40 lbs.
19-inch Monitor	18.7" H x 18.9" W x 19.9" D; 71.6 lbs.
Power Requirements	Voltage and Frequency; 100-120/200-240 VAC
Heat Dissipation	1320 BTU/hour (Indigo² IMPACT) 1000 BTU/hour (Indigo² XZ/XL)
Ambient Temperature	+ 13 to + 35 degrees C operating - 10 to + 65 degrees C non-operating
Relative Humidity	10% to 80% operating no condensation 10% to 95% non-operating no condensation
Altitude	10,000' operating; 40,000' non-operating
Vibration	0.02", 5-19Hz; 0.35 G, 19-500Hz

Regulatory Agency Approvals

Electromagnetic Emission	FCC Class A Canada DOC. Class A CISPR 22 Class B Germany VDE Class B VCCI Class 2
Product Safety	EN55022 Class B UL 1950 CSA 22.2, No. 950 IEC 950 EN 60950 Class 1 SELV

SiliconGraphics
Computer Systems

For more information please call

U.S. 1(800) 800-7441
Europe (41) 22-798.75.25
Asia Pacific (81) 3-54.88.18.11
Intercontinental 1(415) 390.46.14
Latin America 1(415) 390.46.37
Canada 1(905) 625-4747

Silicon Graphics World Wide Web Server
URL:http://www.sgi.com/

Indigo² IMPACT Home Page
URL:http://www.sgi.com/Products/Indigo2/IMPACT/

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